DOCUMENT RESUME

ED 297 985 SE 049 611

AUTHOR Hales, Carma M.; Jones, Maurine E.
TITLE Managing Your Mathematics Program: A Total System. A Guide to the U-SAIL Basic Mathematics System.
INSTITUTION Utah System Approach to Individualized Learning Project.
SPONS AGENCY Department of Education, Washington, DC.
PUB DATE 88
NOTE 37p.; Most of the document is printed on colored paper. Portions contain small print.
PUB TYPE Guides - Classroom Use - Guides (For Teachers) (052)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Arithmetic; Basic Skills; Class Organization; Elementary Education; *Elementary School Mathematics; Instructional Improvement; *Management Systems; *Mastery Learning; Mathematics Education; *Mathematics Instruction; Recordkeeping; Skill Development
IDENTIFIERS *Utah

ABSTRACT

The Utah System Approach to Individual Learning (U-SAIL) Mathematics System was developed to make it possible for teachers to provide excellence in arithmetic instruction. It is based on the premise that in order to teach arithmetic well, teachers must accurately assess, teach directly, provide students with focused practice, corrective feedback, active learning time, and application of each mathematics concept taught until it is determined that a concept has been mastered. The system includes all of the elements necessary for the planning, organization, management and instruction of basic arithmetic concepts. The program outlined includes discussion and suggestions on five steps: (1) plan what you want to accomplish; (2) know the content to be taught; (3) organize for instruction; (4) establish a management system; and (5) teach effectively and efficiently. The sixth stage is a systematic approach to the classroom in action through a review of critical steps. The document also includes a content list for kindergarten through sixth grade mathematics concepts, a sequence for instruction, and a time schedule for a mathematics class. (PK)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED297985

A Guide to the U-SAIL Basic Mathematics System

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

X This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Carma M. Hales

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

A Practical Program that Ensures Excellence in Instruction

SE049 611

BEST COPY AVAILABLE

MANAGING YOUR MATHEMATICS PROGRAM

A TOTAL SYSTEM

Carma M. Hales, Ph.D.
Maurine E. Jones, M.S.

Utah System Approach to Individualized Learning (U-SAIL) Project
Salt Lake City, Utah

The Utah System Approach to Individualized Learning Project was funded in July of 1970 through a United States Office of Education Title III grant. It has continued through Federal, State, and local funding.

The contents of this publication were developed under a grant from the Department of Education. However, those contents do not necessarily represent the policy of the Department of Education, and you should not assume endorsement by the Federal Government.

Published by:

Utah System Approach to Individualized Learning (U-SAIL) Project
Salt Lake City, Utah

All rights reserved. No part of this guide may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, recording, or by any information storage and retrieval system, without permission in writing from the Utah System Approach to Individualized Learning Project.

The U-SAIL Mathematics System

A System for Excellence in Instruction

TABLE OF CONTENTS

Introduction iv

A Foundation for:

Effective Instruction 1

Meaning and Learning 1

Application and Learning 2

Review and Learning -- Skill Maintenance 2

Introduction to the U-SAIL Mathematics System 3

Step I - Plan What You Want to Accomplish 3

Step II - Know the Content to be Taught 3

A. The Scope of Elementary Arithmetic 3

Summary 4

B. Order or Sequence for Instruction 5

Step III - Organize for Instruction 6

A. Assessment or Testing 6

Summary 6

Step IV - Establish a Management System (blue section) 7

A. Organize Your Materials 7

1. Organize by concepts to be taught 7

2. Organize a collection of math realia 7

3. Identify your material resources 7

4. Don't skip important aspects of instruction 7

B. Use Management Devices 8

C. Organize Your Physical Environment 10

1. Establish a mathematics' environment 10

2. Have a place for everything 10

3. Arrange your space for utility/efficiency 10

D. Organize Efficient Retrieval Systems (Record Keeping) . . . 10

1. Establish on-going teacher-kept records 11

2. Establish individual student-kept records 13

Summary 16

Step V - Teach Effectively and Efficiently (pink section) 17

A. Teaching/Learning Model 17

Summary 18

Step VI - The Classroom in Action -- A Review of Critical Steps . . 19

A. Before You Begin to Teach 20

1. Set Goals 20

2. Plan 20

3. Study Content and Organize 20

4. Identify and Organize Resources 20

5. Establish a Record Keeping System 20

6. Organize Your Classroom Environment 21

B. Once You've Begun to Teach 21

1. Establish Classroom Rules and Procedures 21

2. Begin to Teach, and Review and Assess Where Students Are 21

3. Teach Students How to Keep Records of Daily Work 22

4. Teach Students Procedure for Review and Application, Skill Maintenance 22

5. Interact With Students 22

6. Establish Student Work Groups 22

7. Assess Progress Made 23

8. Refine Program 23

Summary 23

Appendix - 24

Time Schedule for a Mathematics Class 25

INTRODUCTION

Excellence in the instruction of basic arithmetic is a critical teaching responsibility. Making the effort spent most productive in terms of time, energy, and outcomes is a constant teacher challenge. The U-SAIL mathematics system provides teachers with concrete step by step practical procedures, which makes continuous improvement possible. Consistent data on student achievement and attitude gains are evidence that the system works.

If the guide is followed, the U-SAIL Mathematics System can be implemented without special training.

The U-SAIL Mathematics System

A System for Excellence in Instruction

A FOUNDATION FOR EFFECTIVE INSTRUCTION

The U-SAIL Mathematics System was developed to make it possible for teachers to provide excellence in arithmetic instruction. In order to teach arithmetic well, teachers must accurately assess, teach directly, provide students with focused practice, corrective feedback, active learning time, and application of each mathematics concept taught until it is determined that a concept has been mastered.

To teach directly and effectively requires that teachers have knowledge of arithmetic, skill in methods of teaching, and understanding of student behavior. Effectiveness also mandates that teachers maintain high expectations for themselves and for their students.

With the U-SAIL system, teachers, by following the guidelines given, can teach arithmetic in a logical sequential way and guarantee that students will learn the concepts appropriate for them.

MEANING AND LEARNING

In learning anything new, a new learning must be connected in the mind with something that is already known. If there is no connection, learning is fragmentary, without meaning impact, and results cannot be predicted. Because of this important principle of learning, it is necessary in arithmetic that students have opportunity to work with things as well as abstract symbols. (How well each student understands a new arithmetic idea depends on how meaningful a "hook" there is from one learning to the next.) At all levels of arithmetic or mathematics development, there is a need for students to work with concrete objects (manipulatives). This need is never outgrown.

With a system approach, it is important to include specific activities which give a student "manipulative" experiences whenever a new concept is introduced, taught, and practiced.

APPLICATION AND LEARNING

All arithmetic instruction, to have lasting impact on a student, must include understanding beyond "passing a test." If a concept becomes a part of a student's life long bank of math working skills, there must be application. Verbal (story problems concerned with the concept just taught), non-verbal (story problems concerned with math concepts taught at some time but not included in what is being learned currently), and real-life problems (story problems based on real arithmetic experiences), are vital to the total arithmetic program. Application problems build life-long thinking and problem solving skills which are essential to the development of "arithmetic logical thinkers."

For each concept identified, a system should provide ideas and curriculum materials at the application level.

REVIEW AND LEARNING - SKILL MAINTENANCE

Consistent review of content taught is essential in arithmetic instruction. Long term memory of concepts learned requires that concepts be used, reused, and reviewed over and over again. On-going review in arithmetic is essential. To ensure skill maintenance, short review time should be included in each day's schedule.

For each concept identified a system approach includes curriculum materials which provide for on-going (preferable everyday) review.

INTRODUCTION TO THE U-SAIL MATHEMATICS SYSTEM

The U-SAIL Mathematics System includes all of the elements necessary for the planning, organization, management and instruction of basic arithmetic concepts. Arithmetic information, testing, practice, review, and application tools need to be accessible.

It is important that teachers use all the curriculum materials available as diagnostic prescriptive tools. Teachers, not a given textbook nor a bank of materials, make the decisions about what to do, when. Steps for implementation are designed to make success at each implementation phase possible.

Keep in mind that arithmetic is a logical content area with easily defined scope and sequence and that learning gaps between concepts taught are a common cause of student failure. With this knowledge as a base for decisions made, the teacher can move through the U-SAIL developed program without difficulty. Students must have "success possible" experiences.

Details of the Program and Implementation Steps Follow:

Step I -- Plan What You Want to Accomplish

Identify your reasons for teaching arithmetic and key these to what you plan to do. These give the purpose for all activity. One goal is student mastery of basic arithmetic. Also included is development of students who know basic arithmetic skills and who effectively use those skills in life application situations. State, district, school, teacher, and student goals give purpose to your instruction. Always keep your goals in mind. Goals remind us of the purposes for what we do.

Step II -- Know the Content to be Taught

You must be familiar with the content to be taught.

A. The SCOPE of Elementary Arithmetic

For ease in use, a summary of all concepts taught in elementary arithmetic are included on a single page study sheet. For a complete review of objectives with criterion behaviors see the Appendix A.

The Arithmetic Summary Sheet (U-SAIL Mathematics System) included the following:

Column 1, labeled Concept Area, are the concept areas taught (the big arithmetic ideas); Column 2, labeled Concept Code, is a simple coding system to help a teacher, when teaching or identifying materials needs, to decide quickly what to do. For example A/S-7 (add, without regrouping) is more difficult than A/S-1 (add, sums thru 5); Column 3, labeled Concept, contains ideas or smaller concepts within the concept area. With a glance you can see how within each concept, levels of difficulty within a concept gradually increase.

The remaining columns listed as A, B, C, D, E, F, and G on your sheet represent levels of difficulty in development of total arithmetic competency. The levels given correspond roughly with grade levels; A, Kindergarten; B, First Grade; C, Second Grade; D, Third Grade; E, Fourth Grade; F, Fifth Grade; G, Sixth Grade.

Within each level, units on the concepts presented at that level are identified. For example: D 1 is the first concept identified at level D and is A/S-5. By following with your eye across the summary sheet, you can quickly see when specific concepts within the large concept areas are introduced or reviewed at each general difficulty level. Letters were used on curriculum materials rather than grade levels to differentiate general developmental levels without adding the stigma to the designation that grade level often gives. Teachers have found this to be very helpful.

Summary

In short, what the Arithmetic Summary Sheet (U-SAIL Mathematics System) gives you is an overall view of general arithmetic including the concepts, areas, specific concepts taught, a simple coding system, and a mapping of when specific concepts occur in instruction.

On a day-to-day basis, keep your Arithmetic Summary Sheet (U-SAIL Mathematics System) available and use it!

A copy of the Scope and Sequence detailed on the Arithmetic Summary Sheet follows:

U-SAIL MATHEMATICS SYSTEM

CONCEPT AREA	CONCEPT CODE	CONCEPT	A	B	C	D	E	F	G
SETS	SETS-1	description	A2						
	SETS-2	equivalent, nonequivalent	A3	B1					
	SETS-3	1 more or 1 less member	A4						
	SETS-4	numbers 1-4	A5						
	SETS-5	zero	A6						
	SETS-6	numbers 0-10	A7	B2					
	SETS-7	number comparison	A8		C1				
	SETS-8	ordering	A9						
	SETS-9	union of sets	A11						
	SETS-10	partitioning of sets	A12						
WHOLE NUMBERS	WN-1	counting	A1						
	WN-2	ordering 0-10	A10	B4					
	WN-3	writing numbers		B5					
	WN-4	0-100, ordering, skip counting		B9	C3				
	WN-5	Roman numerals			C9				
	WN-6	odd or even, skip counting			C15				
	WN-7	number history						F7	
ADDITION AND SUBTRACTION	A/S-1	add, sums thru 5		B8					
	A/S-2	sub., combs. thru 5		B6					
	A/S-3	add, sub., combs. thru 9		B7					
	A/S-4	add, sub., combs. thru 10		B10	C5				
	A/S-5	add, sub., combs. thru 18		B12	C6	D1			
	A/S-6	3 addends		B13	C7				
	A/S-7	add, without regrouping			C11	D3	E3		
	A/S-8	sub., without regrouping			C12	D3	E3		
	A/S-9	add, regrouping			C13	D4	E4	F4	
	A/S-10	sub., regrouping			C14	D5	E5	F5	
	A/S-11	rounding numbers				D6	E6		
PLACE VALUE	PL V-1	ones & tens		B3	C2				
	PL V-2	ones thru hundreds			C4				
	PL V-3	ones thru thousands			C10				
	PL V-4	ones thru hundred thousands				D2	E1		
	PL V-5	ones thru hundred millions					E2	F1	
	PL V-6	large magnitude, exponents						F2	G1
	PL V-7	place value base systems						F3	
	PL V-8	numeration and place value							G2
MEASUREMENT	ME-1	time-hour, half hour		B11					
	ME-2	time-5 minutes			C8				
	ME-3	length-inches, centimeters		B15					
	ME-4	Length-inches, centimeters, meters			C18				
	ME-5	volume-cups, pints, quarts, liters		B16					
	ME-6	volume-gallons, milliliters			C19				
	ME-7	length, perimeter, area, volume				D11	E13		
	ME-8	money-pennies, nickels, dimes		B18					
	ME-9	metric system						F14	
FRACTIONS	FR-1	fractions-emphasis on 1/2, 1/3, 1/4		B14					
	FR-2	fractions-emphasis on halves thru fifths			C17				
	FR-3	fractions-emphasis on halves through eighths				D14			
	FR-4	fractions-parts of whole					E14		
	FR-5	fractions-comparison					E15	F13	G8
	FR-6	fractions-improper, mixed numbers					E16		
GEOMETRY	GE-1	shapes		B17	C20				
	GE-2	plane figures				D13			
	GE-3	plane figures, congruency, parallel lines						F11	G14
	GE-4	circles					E18		
	GE-5	geometric solids					E19		G11
	GE-6	angles						F10	G5
	GE-7	geometry-area, volume, surface area						F12	G10
	GE-8	triangles							G7
	GE-9	circles-circumference, area							G12
MULTIPLICATION AND DIVISION	M/D-1	mult., facts thru 5			C16				
	M/D-2	mult., facts thru 9				D7			
	M/D-3	division, single digits				D8			
	M/D-4	mult., facts and single digit multipliers				D9	E7		
	M/D-5	division, 1 digit divisor				D10	E8	F8	
	M/D-6	mult., regrouping					E9	F9	G3
	M/D-7	division, multi-digit divisor					E10	F6	G4
	M/D-8	averages					E11		G13
	M/D-9	factors, primes, multiples						F15	G6
	M/D-10	rounding numbers					E12	F16	
GRAPHS AND FUNCTIONS	GR-1	graphs				D12	E20		
	GR-2	graphing-4 quadrants						F17	
	GR-3	graphing-4 quadrants, functions							G14
FRACTIONS ADDITION AND SUBTRACTION	FR-A/S-1	fractions-add, sub., like denominators					E17	F18	
	FR-A/S-2	fractions-add, sub., unlike denominators						F19	G9
	FR-A/S-3	fractions-add, sub., mixed numbers						F20	G15
FRACTIONS MULT./DIV.	FR-M/D-1	fractions-multiplication						F21	G16
	FR-M/D-2	fractions-division							G17
DECIMALS	DE-1	decimals						F22	G18
	DE-2	rounding decimals							G19
DECIMALS ADD/SUB.	DE-A/S-1	decimals-add and sub.						F23	G20
DECIMALS MULT./DIV.	DE-M/D-1	decimals-multiplication							G21
	DE-M/D-2	decimals-division							G22
RATIO AND PROPORTION	RA-1	ratio and proportion							G23
	RA-2	ratio, probability							G24
PERCENT	PER-1	percent							G25
INTEGERS	IN-1	integers-add, sub.							G26

Letters A through G refer to approximate grade levels (e.g. A-Kindergarten, G-6th grade). Numbers within the grade level columns refer to a possible order for introducing the concept.

SEQUENCE OF ARITHMETIC SUMMARY SHEET

B. SEQUENCE

Note: (The information on the following sheet provides a Table of Contents for Kindergarten through Sixth Grade math concepts [units] taught, and a sequence for instruction.)

U-SAIL MATH CONCEPTS

Organized In Sequence For Instruction

LEVEL A

Order	Concept
1	WN-1 counting
2	SETS-1 description
3	SETS-2 equivalent, nonequivalent
4	SETS-3 1 more or 1 less member
5	SETS-4 numbers 1-4
6	SETS-5 zero
7	SETS-6 numbers 0-10
8	SETS-7 number comparison
9	SETS-8 ordering 0-10
10	WN-2 ordering 0-10
11	SETS-9 union of sets
12	SETS-10 partitioning of sets

LEVEL B

Order	Concept
1	SETS-2 equivalent, nonequivalent
2	SETS-6 numbers 0-10
3	WN-3 writing numbers
4	WN-2 ordering 0-10
5	A/S-1 add sums thru 5
6	A/S-2 sub. combs. thru 5
7	A/S-3 add, sub., combs. thru 9
8	PI V-1 ones and tens
9	WN-4 0-100, ordering, skip counting
10	A/S-4 add, sub., combs. thru 10
11	ME-1 time-hour, half hour
12	A/S-5 add, sub., combs. thru 18
13	A/S-6 3 addends
14	FR-1 fractions-emphasis on 1/2, 1/3, 1/4
15	ME-3 length-inches, centimeters
16	ME-5 volume-cups, pints, quarts, liters
17	GE-1 shapes
18	ME-8 money-pennies, nickels, dimes

LEVEL C

Order	Concept
1	SETS-7 number comparison
2	PI V-1 ones and tens
3	WN-4 0-100, ordering, skip counting
4	PI V-2 ones thru hundreds
5	A/S-4 add, sub., combs. thru 10
6	A/S-5 add, sub., combs. thru 18
7	A/S-6 3 addends
8	ME-2 time-5 minutes
9	WN-5 Roman numerals
10	PI V-3 ones thru thousands
11	A/S-7 add, without regrouping
12	A/S-8 sub., without regrouping
13	A/S-9 add, regrouping
14	A/S-10 sub., with regrouping
15	WN-6 odd or even, skip counting
16	M/D-1 mult., facts thru 5
17	FR-2 fractions-emphasis on halves thru fifths
18	ME-4 length-inches, centimeters, meters
19	ME-6 volume-gallons, milliliters
20	GE-1 shapes

LEVEL D

Order	Concept
1	A/S-5 add, sub., combs. thru 18
2	PI V-4 ones thru hundred thousands
3	A/S-7, 8 add, sub., without regrouping
4	A/S-9 add with regrouping
5	A/S-10 sub. with regrouping
6	A/S-11 rounding numbers
7	M/D-2 mult. facts thru 9
8	M/D-3 division-single digits
9	M/D-4 mult.-facts and single digit multipliers
10	M/D-5 division-1 digit divisor
11	ME-7 length, perimeter, area, volume
12	GE-2 plane figures
13	GR-1 graphs
14	FR-3 fractions-emphasis on halves through eighths

LEVEL E

Order	Concept
1	PI V-4 ones thru hundred thousands
2	PI V-5 ones thru hundred millions
3	A/S-7, 8 add, sub., without regrouping
4	A/S-9 add with regrouping
5	A/S-10 sub. with regrouping
6	A/S-11 rounding numbers
7	M/D-4 mult.-facts and single digit multipliers
8	M/D-6 mult. with regrouping
9	M/D-5 division-1 digit divisor
10	M/D-7 division, multi-digit divisor
11	M/D-8 averages
12	M/D-10 rounding numbers
13	ME-7 length, area, volume, perimeter
14	FR-4 fractions-parts of whole
15	FR-5 fractions-comparison
16	FR-6 fractions-improper, mixed numbers
17	FR-A/S-1 fractions-add, sub., like denominators
18	GE-4 circles
19	GE-5 geometric solids
20	GR-1 graphs

LEVEL F

Order	Concept
1	PI V-5 ones thru hundred millions
2	PI V-6 large magnitude, exponents
3	PI V-7 place value base systems
4	A/S-9 add-with regrouping
5	A/S-10 sub.-with regrouping
6	M/D-6 mult.-regrouping
7	WN-7 number history
8	M/D-5 division-1 digit divisor
9	M/D-7 division-multi-digit divisor
10	M/D-10 rounding numbers
11	M/D-8 averages
12	M/D-9 factors, primes, multiples
13	FR-5 fraction comparison
14	FR-A/S-1 fractions, add, sub., like denominators
15	FR-A/S-2 fractions-add, sub., unlike denominators
16	FR-A/S-3 fractions-add, sub., mixed numbers
17	FR-M/D-1 fractions-multiplication
18	DE-1 decimals
19	DE-A/S-1 decimals-add and sub.
20	GE-6 angles
21	GE-3 plane figures, congruency, parallel lines
22	GE-7 geometry-area, volume, surface area
23	GR-2 graphing-4 quadrants
24	ME-9 metric system

LEVEL G

Order	Concept
1	PI V-6 large magnitude, exponents
2	PI V-8 numeration and place value
3	M/D-6 mult., regrouping
4	M/D-7 division, multi-digit divisor
5	M/D-9 factors, primes, multiples
6	GE-6 angles
7	GE-8 triangles
8	FR-5 fractions-comparison
9	FR-A/S-2 fractions-add, sub., unlike denominators
10	FR-A/S-3 fractions-add, sub., mixed numbers
11	FR-M/D-1 fractions-multiplication
12	FR-M/D-2 fractions-division
13	RA-1 ratio and proportion
14	DE-1 decimals
15	DE-2 rounding decimals
16	DE-A/S-1 decimals-add and sub.
17	DE-M/D-1 decimals-multiplication
18	DE-M/D-2 decimals-division
19	GE-9 circles-circumference, area
20	GE-7 geometry-area, volume, surface area
21	GE-5 geometric solids
22	PER-1 percent
23	IN-1 integers-add, sub.
24	GR-3 graphing-4 quadrants, functions
25	RA-2 ratio, probability
26	GE-3 plane figures, congruency, parallel lines

5A

U-SAIL GENERAL MATHEMATICS SCHEMA

FOR MIDDLE/JUNIOR HIGH SCHOOLS

SETS AND WHOLE NUMBERS
- SETS-1 sets and their members
- SETS-2 sets and subsets
- SETS-3 comparing sets
- SETS-4 naming sets
- SETS-5 whole numbers
- SETS-6 operations on sets

NUMERATION SYSTEMS
- NUM-1 place value (base 10)
- NUM-2 place value (any base)
- NUM-3 prime numbers
- NUM-4 exponents
- NUM-5 square roots
- NUM-6 expanded notation
- NUM-7 real numbers
- NUM-8 ancient numeration systems
- NUM-9 number sentences
- NUM-10 equivalent and non-equivalent relations

ADDITION AND SUBTRACTION
- A/S-1 basic facts
- A/S-2 properties
- A/S-3 add with regrouping
- A/S-4 subtract with regrouping
- A/S-5 three addends
- A/S-6 estimating

MULTIPLICATION AND DIVISION
- M/D-1 properties
- M/D-2 multiplication facts
- M/D-3 multiplication regrouping
- M/D-4 division
- M/D-5 averages
- M/D-6 estimating
- M/D-7 primes and factors
- M/D-8 multiples

MEASUREMENT
- ME-1 history and systems of measurement
- ME-2 linear measurement
- ME-3 perimeter
- ME-4 area
- ME-5 surface area
- ME-6 volume/capacity
- ME-7 mass
- ME-8 time
- ME-9 temperature
- ME-10 angles
- ME-11 metric system

GEOMETRY
- GE-1 primitive geometric terms
- GE-2 closed curves and plane regions
- GE-3 angles
- GE-4 triangles
- GE-5 polygons
- GE-6 circles
- GE-7 solid figures
- GE-8 congruent figures
- GE-9 constructions
- GE-10 transformations
- GE-11 symmetry

RATIONAL NUMBERS/FRACTIONS
- RN-1 rational numbers
- RN-2 fractions
- RN-3 comparing fractions
- RN-4 mixed forms
- RN-5 properties
- RN-6 addition and subtraction
- RN-7 multiplication and division
- RN-8 complex fractions
- RN-9 equations and inequalities

DECIMAL NUMBERS
- DE-1 decimals
- DE-2 properties
- DE-3 conversion of decimals & fractions
- DE-4 terminating, nonterminating and repeating decimals
- DE-5 addition and subtraction
- DE-6 multiplication and division
- DE-7 estimating

INTEGERS
- IN-1 integers and the number line
- IN-2 order and comparison
- IN-3 addition
- IN-4 subtraction
- IN-5 multiplication
- IN-6 division
- IN-7 properties
- IN-8 absolute value

GRAPHS AND FUNCTIONS
- GR-1 bargraphs, line graphs, etc.
- GR-2 cartesian coordinate system
- GR-3 functions and graphs
- GR-4 descriptive statistics
- GR-5 functions

RATIO, PERCENT, AND PROBABILITY
- RA-1 ratio
- RA-2 proportion
- RA-3 percent
- RA-4 scale drawings
- RA-5 probability
- RA-6 permutations and combinations

Step III -- Organize for Instruction

A. Assessment or Testing

In order to know where to begin instruction, you must find out what students know and don't know. A testing program or materials at each level of difficulty need to be identified. These may be available through state, district, or school resources. Commercial tests and teacher made tests are options.

B. An Arithmetic Resource Bank

1. The Purpose of an Arithmetic Resource Bank

An arithmetic resource bank should be a dynamic growing set of meaningful resources to which you, as a teacher, can go for immediate specific and accurate information, ideas, strategies, student activities, visuals and whatever else can be put together by concept to give as complete as possible an inventory of resources available.* Your resource bank is never complete. You can add resources commercial, teacher-made, and other materials, as they are identified. As a bank grows, its value also grows, especially if it is used and becomes your reference to all resources on a given topic.

2. The Contents of an Arithmetic Resource Bank

Regardless of the level, both teacher and student materials are needed. These materials include strategies for teaching, assessment, practice activities, skill maintenance exercises, and application activities.

Summary

The organization of an arithmetic resource bank with a simple coding system provides a filing system for all teacher and student resources. Teacher-made materials and commercial materials are acquired, then may be coded and included in the bank, or if they cannot be placed in the bank, they may be referenced in the bank.

* The U-SAIL Elementary Arithmetic System or the General Mathematics Schema for Middle/Junior High School provides the skeleton for setting up a resource bank. Other schemas--your state, district or school schema--may be used. The important thing is to identify one that is concept structured.

Step IV -- Establish a Management System

A. Organize Your Materials

Identify and organize materials to be used for instruction.

1. Organize by concepts to be taught. Your resource file will be a constant reference.

2. Organize a collection of math realia, (concrete objects) which can be used to manipulate. Have these in one designated place. Include realia of different sizes and shapes. You can add to this collection as your program grows. Identify your material resources.

3. The textbooks or books you are going to use should be organized for quick accessibility. Where possible have texts on a minimum of three grade levels. The level you are assigned, one above and below. The teacher and materials available determine what can actually be used. The textbooks provide practice materials after instruction.

   Note: Remember, as a teacher, you are teaching for mastery. That means that you teach concept by concept.

4. Don't skip important aspects of instruction. As you prepare resources, keep in mind that you must not skip steps essential to learning the concept such as:

   a. assessment procedures.
   b. labeling-telling students what is to be learned.
   c. teaching each concept - checking understanding.
   d. including manipulative activities in practice. Students must grow from a concrete to an abstract base. Each new concept taught should include, when possible, experience with things that can be handled. This helps develop the idea in students' minds because they can use an activity which can be related directly to their own experience base. An example of how to move from concrete to abstract experience follows:

(1) Begin with actual objects (manipulative activity).

3 balls + 3 balls = 6 balls (using balls themselves)

(2) Next use pictorial representations of the actual objects.

(3) Next use abstract visual symbols.

/// + /// = 6

(4) Finally, work with symbols alone.

3 + 3 = 6

Symbolic activities provide mathematics practice to build toward mastery and do not necessarily include working with objects.

Application activities are experiences designed to give students opportunity to use the skill they have learned.

Note: These activities can be used as review for students who are working on other concepts. They provide a necessary constant link between arithmetic practice and life's realities. They can be used as assigned activities or student choice activities for building program breadth and enrichment.

B. Use Management Devices

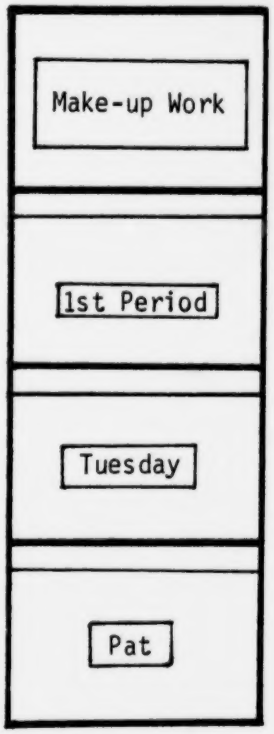
Management devices (charts, lists, etc.) enable you to know precisely where students are and to be able to hold them accountable for their performance. Charts can show general group assignments, center or other special activity assignments, testing schedules, special duty assignments, etc.

Note: Management visuals should meet specific needs. Some teachers use lists or small notebook size charts; while others use wall charts.

The important thing to remember is that each teacher must have an organized way of assigning and reassigning students to participate in specific activities and ways to give students visual cues to help them understand concepts.

One kind of management visual is a pocket chart. A chart may be made using looseleaf protectors and taping them onto a piece of tag or poster board to form pockets.

To prepare the above type chart, you need four pieces of 11-1/2" x 10" poster board and three 11" x 8-1/2" acetate looseleaf protectors. Begin by slipping the 3/4" opening flap of the acetate over the edge of the long side of the poster board. Tape this down covering the flap with tape to secure it to the poster board. (This will be the back of your chart.) The acetate will make a pocket when the sides are taped down. Continue by making three acetate pockets and leave one plain poster board at the top of the chart for a label (i.e. make-up work, tests, assignments, etc.). After the pockets are made, place the poster boards either in a horizontal line or vertical line and tape them together with colored masking (or other) tape.



Remember to leave a small space, about 1/16", between the poster boards so they will fold flat. It is important to make materials file-size so they can be stored and filed in places where they are accessible and easily found.

By scotch taping labels such as days of the week, periods, or time slots to the acetate pockets, various worksheets or other materials can be designated and disseminated.

You will find many uses for this kind of chart. It can be used for:

1. make-up work
2. extra work
3. assignments
4. pre-tests
5. post tests
6. application activities
7. computational drill
8. practice sheets
9. etc.

By making charts on different colored poster board or using different colored masking tape, they can be used to disseminate materials for specific groups (i.e. two or three different math groups).

C. Organize Your Physical Environment

Organize your physical environment to make individualized mathematics instruction possible.

1. Establish a mathematics' environment. Label what you are doing--emphasize basic skill development progress by visuals.

2. Have a place for everything:

   -- curriculum materials to be stored.
   -- realia (math materials, counters, cubes, whatever you can collect).
   -- a checking station.
   -- centers where games, etc., which are limited in number can be used. Avoid collision courses--high barriers.
   -- student records, data sheets and work to be stored. (Use of two or three mini-files is suggested.)
   -- sign-up for help charts, etc.
   -- independent application activities.

3. Arrange your space to insure that you are easily accessible to all students. Spatial organization should be based on utility and efficiency.

   Your total learning area should be functional and flexible.

D. Organize Efficient Retrieval Systems (Record Keeping)

Design a way to keep accurate day-by-day records of what is happening in the classroom.

To be most effective, this necessitates development of both student-

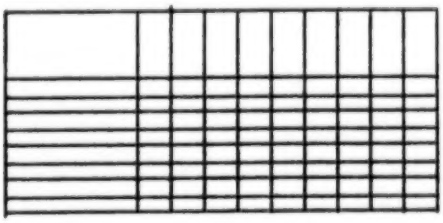
kept and teacher-kept records of student progress.

1. Establish on-going teacher kept records. The teacher managed system should include a group progress record of concepts to be taught and mastered. Use of either a grid or looseleaf notebook is recommended.

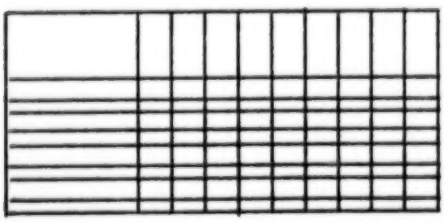
   Across the top of the grid or page, you should list the concepts to be taught. Names of the students should be listed down the side of the record.

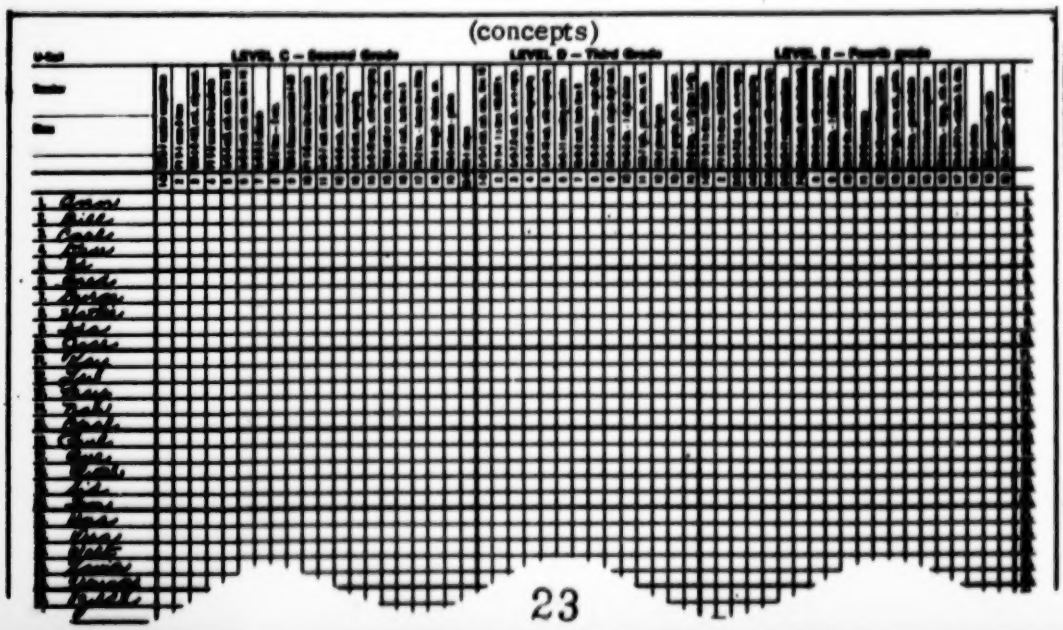
   Most teachers use two teacher retrievals or records. Models for teacher kept records follow:

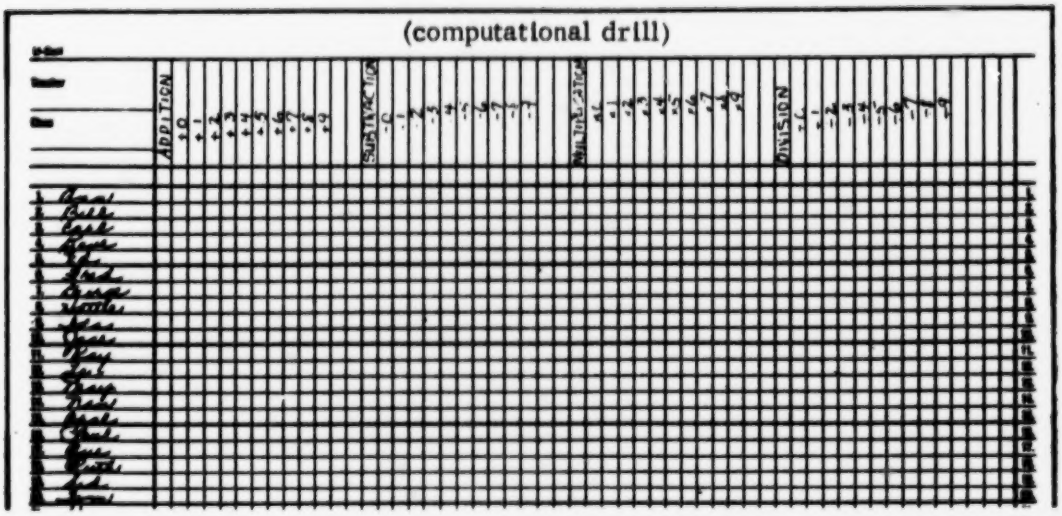
concepts



computational drill







Remember, a record should give you data to make decisions about instruction. You need to see quickly possible grouping patterns and what individual learners know and don't know.

It is important to know who knows what, what next steps are, and whether or not a student has had instruction.

A simple way some teachers monitor progress is by marking their group retrievals or records as follows:

a dot to show instruction has occurred.

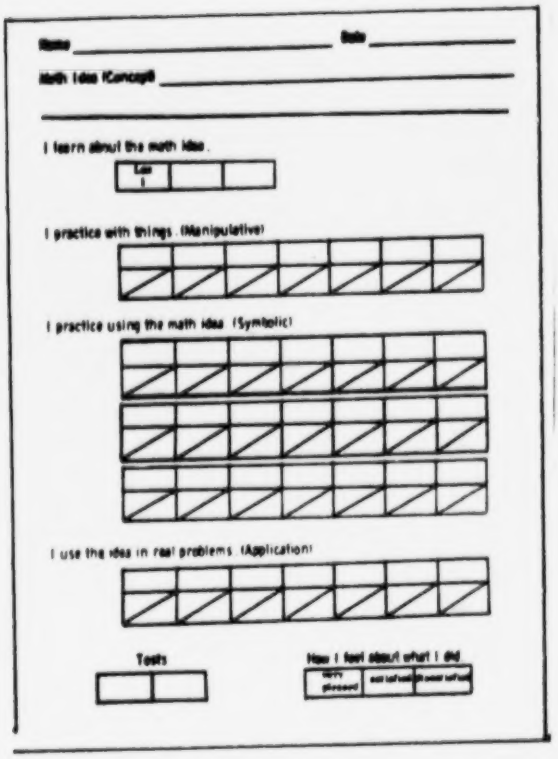
a slash to show initial concept mastery.

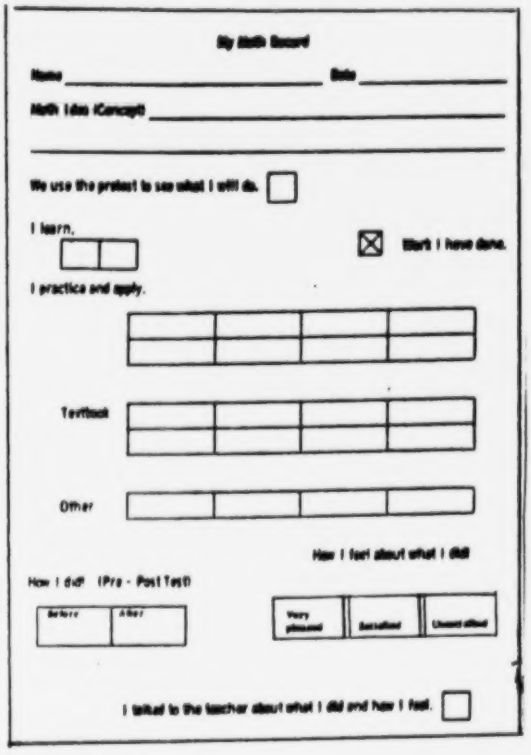
additional slash to show review of concept at a later date.

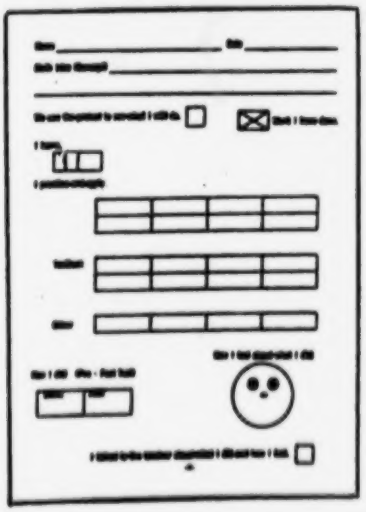
another slash; another review.

A way to show what a student chooses for himself to do
A way to show completion of each activity
A way to show how a student feels about what he has done
A way to show when conferencing has occurred

Some models for student-kept records follow:


Name
Date
Math Idea (Concept)
I learn about the math idea.
I practice with things. (Manipulative)
I practice using the math idea. (Symbolic)
I use the idea in real problems. (Application)
Tests
How I feel about what I did





Learning activity options listed on the student retrieval form make it possible to use available resources.

Some teachers find it helpful to duplicate, for each student, copies of the individual retrievals with activity options listed. This prevents frustrations. A teacher-kept master copy of the retrieval for a given concept is helpful. It serves as a quick inventory of resource potential and allows for exact monitoring of what has or has not been assigned. Obviously, this will change as new resources are found.

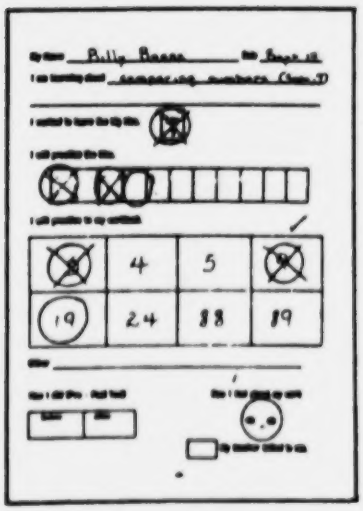
The student starts with a retrieval sheet stapled in a folder. This sheet will show what activities the student completed to practice and apply the concept labeled at the top of the sheet. When the concept is initially mastered, backup worksheets are filed or sent home and a new retrieval sheet for the next concept to be learned is stapled in over the top of the one just learned.

By stapling each concept retrieval sheet to the individual folder, a cumulative record is available and maintained by the student. Opportunity to be responsible is given. Progress over time is documented. Data for parent-teacher conferences, student-teacher conferences are ever present.

Not every learner should be required to complete every option when learning a specific concept. Leaving some textbook pages unassigned is critical. Students can then be directed to go back and do textbook pages previously unassigned. This method provides periodic review of a concept without requiring a great deal of teacher preparation.

It is important to teach a marking system that will enable you to get feedback quickly. One way is to have students circle assignments made. Then, have students put a cross through a circle when work is completed, or write a score.

Some teachers have younger students use crayons (i.e., a red crayon for circles, a blue crayon for crosses). Color provides a vivid visual for quick check and constant monitoring.



It is important that students be required to keep worksheets, which are backup data for work completed, in their folder.

Summary

Effective management necessitates that each teacher:

1. Identify and organize diagnostic/prescriptive materials to be used for instruction.

2. Design efficient management procedures.

3. Organize an individualized functional and flexible physical environment.

4. Design an on-going system for keeping an accurate record of student progress. This includes teacher records of concepts mastered, computational drill, and individual student records.

Some teachers prefer more data. What is important is that a teacher has adequate information to prescriptively group to help individual learners and to provide scheduled reteaching or review.

Most teacher-managed mathematics systems include a group progress record of computational skill in addition, subtraction, multiplication, and division. The progress record should follow conceptual skill development and can be kept on a grid or in a looseleaf or notebook.

Facts or other skills to be learned (counting, addition, subtraction, multiplication facts) should be identified and listed across the top of the page or grid.

Student names should be added along the side of the record.

In computation, accuracy is the first goal; speed is second.

Blocks can be colored in or crossed off as accuracy is attained. The "holes" or spaces left indicate specific drill need.

a. Cumulative Records

Cumulative records kept on student progress are usually district mandated. If left to teacher decision-making, a composite record of what concepts each student has mastered should be maintained.

2. Establish individual student-kept records.

a. Make an individual file, or folder, or notebook for each student.

Select or design a student record which will provide on-going data of work assigned and completed within a single concept. Student-kept records can provide the structure for assignments given and student choices made. Include in student-kept records the following:

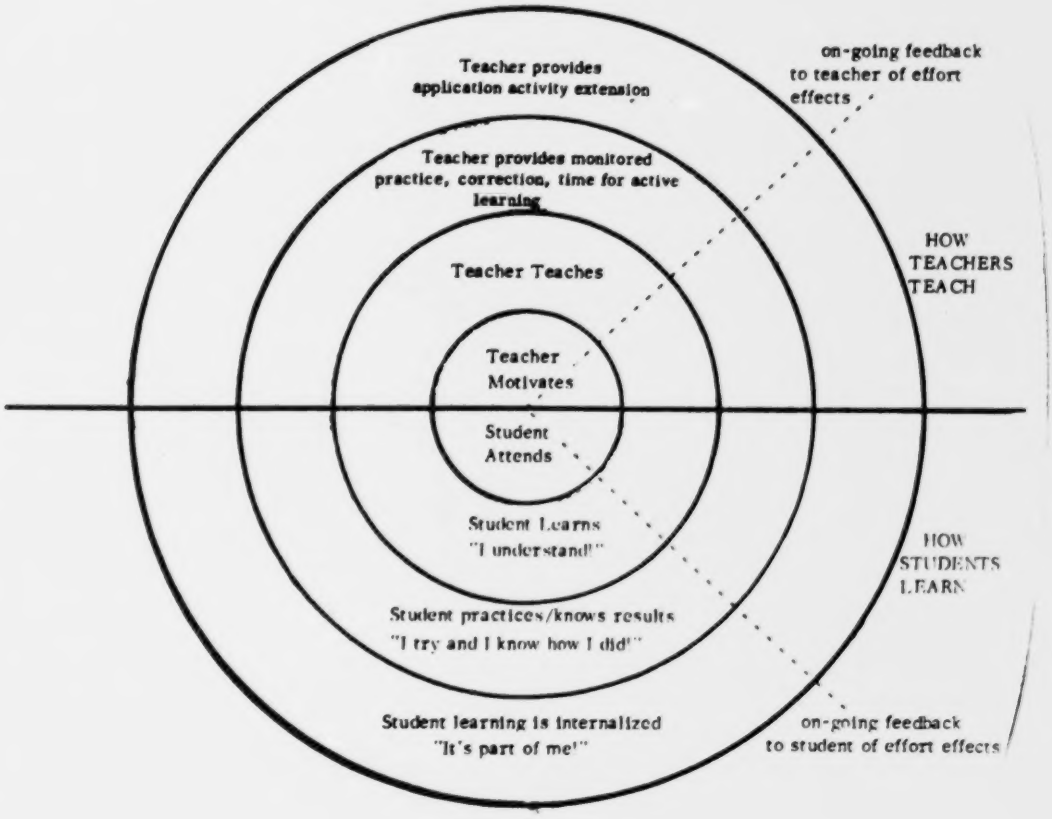
Name of student and date
What concept a student is working with
An inventory of all possible learning activities to
to practice and apply concept
A way to show what the teacher assigns

Step V -- Teach Effectively and Efficiently

Precise direct teaching is most productive when teaching a concept. A simple teaching/learning model follows which describes what teachers do in order to ensure that students learn.

A. Teaching/Learning Model

U-SAIL TEACHING/LEARNING MODEL


Teacher provides application activity extension
on-going feedback to teacher of effort effects
Teacher provides monitored practice, correction, time for active learning
HOW TEACHERS TEACH
Teacher Teaches
Teacher Motivates
Student Attends
Student Learns "I understand!"
HOW STUDENTS LEARN
Student practices/knows results "I try and I know how I did!"
Student learning is internalized "It's part of me!"
on-going feedback to student of effort effects

The teachers prescribe with precision, based on knowledge of student behaviors.

Classroom activity is reviewed, evaluated, and revised, based on how students are responding to stimuli offered. Provision must be made for student independent work, (practice and application), teacher-directed large group, small group and individual instruction, and on-going oral and written feedback for students and teachers.

Once a concept has been taught, closely monitored practice is provided to set the concept. Active learning time is stressed. Students need immediate knowledge of results. As practice on a concept becomes more independent and skills are set, application experiences are provided so the student will be able to apply the concepts and skills in varied situations. Student learning then becomes internalized.

Summary

Precise teaching follows a simple teaching/learning model which takes students from where they are and effectively brings them to the point where mathematics concepts and skills are an internalized part of their behavior.

This includes teaching strategies, monitored practice (including manipulative and symbolic experiences) and application experiences. Pre and post assessment provides measures for the diagnostic teaching.

Direct teaching is used to teach concepts, then once skill working with a concept is demonstrated, application, use of concepts, and student independence is emphasized.

Step VI -- The Classroom In Action--A Review of Critical Steps

Remember, that teaching math effectively and individualizing math go hand in hand. As you are able to match learners with appropriate tasks, the probability that learners will learn increases. Becoming more and more responsive to each learner's needs is a continuous challenge.

Making your program work for you requires that you plan, organize, manage, and teach, using all of the resources you have available. In a systematic way, you approach the teaching task. To be most effective the program you teach must become yours.

A. Before You Begin to Teach	I have done this	My next step
1. Set Goals Establish the purpose for what you are doing. (Ideal Goals) You are interested in working toward development of students who know mathematics, like mathematics, and use mathematics to solve problems. Responsible citizenship, independence, esteem for self and others, personal accountability, and the ability to use thinking skills well, are important goals which cannot be separated from teaching content. These elements all need to be considered.		
2. Plan Work out a tentative plan which will fit your situation. (Establish a work base, and work goals.)		
3. Study Content and Organize Study the content to be taught and organize what you will teach in sequence. (This may be decided by your district.)		
4. Identify and Organize Resources Identify, or design and organize materials to help with teaching and practicing the skills or elements identified. For ease in use, code materials and file them according to the skills you are going to teach. Don't forget to include use of multi-media tools such as the computer.		
5. Establish a Record Keeping System Design a system for keeping track of learners progress, e.g., teacher-kept group retrievals (records) and individual student-kept records. Have multiple copies of student-kept forms ready before program is begun.		

I have done this	My next step

6. Organize Your Classroom Environment

   Organize your teaching environment to include multi-level difficulty material, places for math activity, and math material storage. The classroom must be a clean, orderly, attractive place to learn with teaching space which gives options for large group, small group, and independent activity.

B. Once You've Begun to Teach

Remember that feelings and learning are never separated. Students' cognitive and affective behaviors go hand in hand. Your task is establishing a humane environment which is accepting, valuing, and expecting. High expectations for you and your students is a must.

Start one new procedure at a time, establish it, then go to the next step.

I am doing this	I need to start

1. Establish Classroom Rules and Procedures

   Set guidelines in terms of what will happen when, under what circumstances.

2. Begin to Teach, and Review and Assess Where Students Are

   Begin your instruction. To do this, start with review work which will help you identify who can and cannot work on grade level. At this point you teach, introduce, reinforce, review, provide practice, monitor the practice, and provide for learner feedback on work done. Remember this is an instructional time. It is not just a time for working on assigned tasks.

	I am doing this	I need to start
3. Teach Students How to Keep Records of Daily Work Introduce and distribute individual retrievals (student-kept records) and explain how they will be used, where they will be kept when not in use, and how they will be distributed each day. These provide written feedback for both you, the teacher, and the student.		
4. Teach Students Procedure for Review and Application, Skill Maintenance Introduce a review and application, independent student math program. Explain the importance of using math in life activities, and the procedures that will be followed. At the beginning of each math period, have students mark individual records and work independently on skill maintenance unless they are otherwise assigned. This gets your class off to a good start with students "on task".		
5. Interact With Students Install formal and informal conferences with learners. Each student should have a formal conference about what he has done as often as possible. The number of students you have determines how often you can conference individually with students. Maintain informal checks each day as you work throughout the room monitoring, encouraging, and helping students.		
6. Establish Student Work Groups To form these groups, work with the whole group or your instructional groups and observe specific skills. As you identify students who need help, group them together and work with their common problem. While you are teaching a sub-group, the remainder of the class is working independently on activities at an independent practice or application level.		

	I am doing this	I need to start
7. Assess Progress Made Use your group records or retrievals and your own judgment to indicate who has mastered what concepts. Most teachers prefer to mark their retrieval (records) during rather than after class. Keep records which help you to make better decisions about learners.		
8. Refine Program Continue to refine all aspects of your program. Group and regroup students as needed.		

Summary

When your program is operational, you will have installed an instructional mathematics program review and application mathematics activities, student-kept and teacher-kept retrieval systems, individual interactions and on-going daily monitoring, and needs groups. (Teaching usually takes about 50% of the time.)

When all of these program phases are functioning, students will work more and more on activities appropriate for them. You will be teaching at students' instructional levels, providing practice, feedback, and application. Students will be accountable for "success possible" tasks. The program will become increasingly adaptive to each learner's needs.

The result will be a system approach to mathematics instruction which is conceptually sound, adaptive to student differences, practical to manage, and effective in terms of insuring instructional excellence.

APPENDIX

TIME SCHEDULE FOR A MATHEMATICS CLASS
(an example)

Beginning Task Assignment and Students Recording on Individual Record	8-10 minutes
Daily Practice/Application Review or Weekly or Monthly Review	
Teaching Time (Basic Skill Development Time)	15-20 minutes
Motivation/Introduction Teaching or Re-teaching with Understanding Checked Before Practice Assigned	
Practice and Application Time	15-20 minutes
Monitored Group Practice, or Independent Activities Monitored Group Application or Independent Activities	
Summary - Next Steps Time	3-5 minutes
Assignment Period Evaluation with Goals Identified	

Note: One group may be involved in a teaching time while others are engages in practice/application/extension activities. Feedback provisions must be made for students working independently.